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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/285,986	04/05/1999	SHIH-SHIUNG CHEU	TSMC98-403	4368

28112 7590 01/29/2004

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EXAMINER

BEREZNY, NEMA O

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 01/29/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/285,986	Applicant(s) CHEU ET AL	
	Examiner Nema O B rezny	Art Unit 2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 01 December 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-25 and 27-30 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-25 and 27-30 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 05 April 1999 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 12-1-03 has been entered.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-25 and 27-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dass et al. (6,143,668) in view of Fu et al. (5,807,787). Dass discloses providing top level interconnecting lines (col.1 lines 26-29) and top level bond pads (Fig.5 el.55) comprising aluminum [**claims 2, 21**] and aluminum/copper alloy (col.2 lines 42-46) [**claims 3, 22**], formed on a semiconductor substrate comprising circuit elements therein (col.1 lines 26-33) [**claim 18**]; depositing a passivation layer of silicon nitride over said interconnect lines and said bond pads (el.60; col.2 lines 46-48);

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depositing a photosensitive polyimide layer (el.65) over said passivation layer; patterning and etching said polyimide layer above said bond pads (Fig.6); then patterning and etching said passivation layer above said bond pads **[claims 9, 10, 25]** using He/NF(3) **[claim 15]**, thereby exposing said bond pads (Fig.7; col.2 lines 61-62); then curing and cross-linking said polyimide layer (col.2 lines 63-65), wherein said patterned and etched polyimide is not removed (Fig.8; col.2 lines 63-65) **[claims 1, 12, 20, 27]**. However, Dass does not disclose forming an insulating layer over the main semiconductor substrate surface, or depositing two passivation layers, or forming a bond pad thickness of 4000 – 8000 Angstroms, or forming a polyimide thickness of 5.0 – 9.5 microns, or specific claimed deposition, etching, and curing parameters.

Fu discloses a method of forming bonding pads, comprising: forming an insulating film **[claim 1]** of silicon oxide **[claims 5, 24]** over the semiconductor substrate main surface (col.4 lines 8-28) **[claims 16, 17, 29]**; depositing two passivation layers **[claim 1]** using PECVD at a temperature between 350 and 450 degrees C (col.5 lines 18-21) **[claims 6, 7]**, comprising a plasma enhanced oxide layer and a plasma enhanced silicon nitride layer (col.5 lines 14-18) **[claims 5, 24]** over said insulation layer and over said interconnects and bond pads (col.5 lines 25-26); and depositing a photosensitive polyimide layer (col.5 lines 37-40) at a thickness of 5.0 – 9.5 microns (col.5 lines 47-49) **[claim 8]**. The two said passivation layers have a thickness of 7000 – 12,000 Angstroms (col.5 lines 23-24) **[claims 5, 24]**; the oxide passivation layer uses Ar/CF(4) as an etchant (col.5 lines 27-30) **[claim 14]**; the bond pad thickness is 4000 – 8000 Angstroms (col.5 lines 8-9) **[claims 4, 23]**; the polyimide is patterned and etched

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by cross-linking with ultra-violet radiation through a mask [**claims 13, 28**], and the non-cross-linked polyimide is dissolved away in a solvent over the bond pads (claim 8) [**claim 11**], thereby preventing etching damage and damage of cracking and delamination to the passivation layer (Applicant specification – p.21 lines 1-4) [**claim 27**]; and the polyimide is cured in a nitrogen ambient at a temperature of 300 – 400 degrees C for 1.5 – 2.5 hours (claim 9) [**claims 19, 30**]. Fu also discloses filling keyholes (microscopic openings) between closely spaced interconnect lines (col.7 lines 57-61), wherein a thick layer of photosensitive polyimide precursor solution is spin coated over the passivation layers (col.5 lines 40-45) as disclosed by Applicant to thereby fill any keyholes between interconnect lines (specification – p.17 lines 15-21),. Fu also discloses that said polyimide layer provides a stress buffer and reduces stress impact to the passivation layer (col.5 lines 32-40).

Therefore, it would have been obvious to a person skilled in the art at the time of the invention to use the method of Fu with the method of Dass for forming bonding pads. The two passivation layers of Fu offer the benefits of both an oxide layer, which can relieve stress and therefore avoid cracking, and a nitride layer, which has better moisture resistance than silicon dioxide (Microelectronics Packaging Handbook II, p.477-478). Fu also discloses that PECVD deposition of the passivation layers allows said layers to be deposited at low temperatures (col.5 lines 18-21). Fu also discloses that using a photosensitive polyimide layer provides both a mask and a second passivation layer without the need to etch off photoresist (col.5 lines 37-40). Fu also discloses several items that are typically used in semiconductor fabrication: silicon

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oxide insulation layer (col.4 lines 13-15); Al/Cu bond pads (col.4 lines 11-13); silicon oxide/silicon nitride passivation layer thickness of 7000-12,000 Angstroms (col.5 lines 23-24); and a passivation etchant of Ar/CF(4) (col.5 lines 25-31), wherein any conventionally used fabrication steps would be economically advantageous in terms of equipment, assembly line set-up, materials, and personnel training.

Dass and Fu do not disclose depositing the first passivation layer at a pressure of 2.0 – 2.8 Torr for 8 – 12 seconds **[claim 6]**, and the second passivation layer at a pressure of 4.0 – 5.0 Torr for 50 – 60 seconds **[claim 7]**; or etching the first passivation layer at a pressure of .30 - .40 Torr for 33 – 39 seconds **[claim 14]**, and the second passivation layer at a pressure of 1.2 – 1.3 Torr for 20 – 30 seconds **[claim 15]**. The specification contains no disclosure of either the critical nature of the claimed operating parameters or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Response to Arguments

Applicant's arguments filed 10-2-03 have been fully considered but they are not persuasive. Applicant contends that Dass discloses no pattern of metal interconnect lines. Examiner disagrees. Dass begins the disclosure of his invention with the conventional structure shown in Figures 1 and 2, and the related discussion of such

(col.7 lines 35-46), which includes interconnects (col.1 lines 26-29) as stated in the prior and instant rejections.

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., bond pads and interconnect lines intermixed, and bond pads adjacent to interconnects) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Applicant contends that Dass does not address the occurrence of keyholes between closely spaced layers of interconnect metal, or providing a thick layer of polyimide. As stated in the prior and instant rejections, Fu discloses these features (see prior Office Action, page 3-4).

Applicant contends that the pads of Dass are for testing purposes having a pitch of 80 microns. As stated in the previous Response to Arguments, Dass does not disclose separate or special pads for testing purposes only (col.1 lines 12-14; col.1 line 65 – col.2 line 7). In addition, instant application does not claim any pitch size.

Applicant contends that the claimed sequence of instant invention differs from Dass and/or Fu. Examiner disagrees. As stated in the prior and instant rejections, Dass discloses the claimed sequence of passivation layer(s) deposition, then polyimide deposition, then etching the polyimide, then etching the passivation layer(s) (see page 2 of prior Office Action).

Conclusion


Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nema O Berezny whose telephone number is (703) 305-3445. The examiner can normally be reached on M-F 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr. can be reached on (703) 308-4940. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Effective Feb. 5, 2004, Art Unit 2813 will move to the seventh floor of the Jefferson Building at the new USPTO facility in Alexandria, VA. This examiner can be reached at (571) 272-1686 after Feb. 5, 2004.

NB



JACK CHEN
PRIMARY EXAMINER